DOE Peer Review

Nashville, TN

Integrated Energy Systems

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presented by

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Agenda

- Burns & McDonnell Team Overview
- IES Project Background
- IES Project Approach

Burns & McDonnell Team Overview

Burns & McDonnell

IES Program Manager

- Integrated design-build company
- Founded in 1898
- 100% employee owned – over 1,600 employees
- More than 100 years expertise with energy generation projects
- 20 regional offices - projects worldwide

Solar Turbines Incorporated

Industrial Turbine Manufacturer

- Subsidiary of Caterpillar
- Leading U.S. supplier of industrial gas turbines ranging from 1 to 13 MW
- Proven technology with strong technical, research & development expertise
- Headquartered in San Diego with a global presence

Broad USA, Inc.

Absorption Chiller Manufacturer

- Worlds largest manufacturer of absorption chillers
- 1,200 units annually = over 500,000 tons with more than 6,000 units in operation
- The only dedicated manufacturer of absorption chillers with a 3.3 million ft^2 manufacturing facility
- Proven track record with the DOE

IES Project Background

IES Statement of Work

Packaged and modular systems development focuses on innovative integration of on-site/near-site power generation and thermally activated systems to be incorporated into individual buildings.

Key IES Technical Areas

- Thermally activated technologies
  - Absorption cooling
  - Thermal heating
  - Humidity controls
- Onsite power technology
- Controls development
- Systems integration

Target Market

- Commercial buildings
- Institutional buildings
- Government facilities
- District energy systems that distribute thermal energy to:
  - College campuses
  - Hospital complexes
  - Industrial parks
  - Commercial campuses

Project Intent

- By **combining existing proven** technologies...
  - Determine if our IES approach is better than existing configurations
  - Determine the optimum configuration of the system
  - Develop a method to size an IES for a specific load profile

IES Project Approach

IES System Concept

- Low emission gas turbine generator
- Two-stage co-gen absorption chiller using turbine exhaust
- Two-stage co-fired absorption chiller using natural gas and turbine exhaust
- Provide electricity, chilled water, and hot water

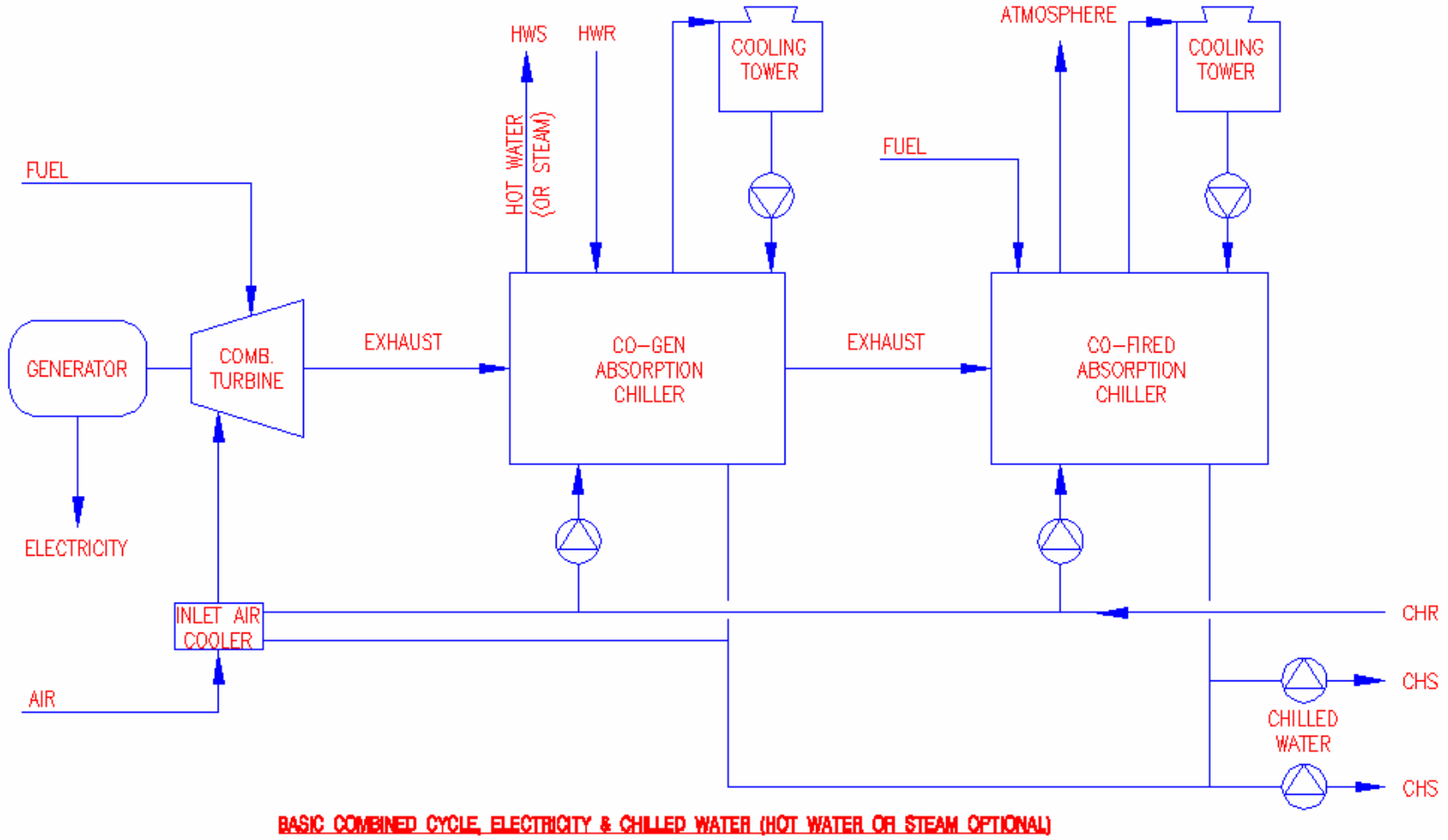
IES Project Approach
(Site Selection)

Site	Location	Score
Brooks AFB	San Antonio	483
UT Health Science	San Antonio	483
UT San Antonio	San Antonio	482
University of Iowa	Iowa City	473
Naval Med Center	San Diego	427
Carnegie-Mellon	Pittsburgh	355
Bunker Hill CC	Boston	307
North Island	San Diego	267

IES Project Approach

- Install IES at Brooks Air Force Base in San Antonio, TX as part of Brooks Energy and Sustainability Lab (BESL)
- Customer will be City Public Service
- Integrate IES into existing chilled water and steam system
- Interconnect to CPS substation with the ability to feed the electric grid

IES System One-Line



Solar Turbines – Centaur 50

- Nameplate: 4.6 MW
- Exhaust: 950 ^{o}F
- Heat Rate: 11,630 HHV
- Low NOx: 15 ppm

Broad - Spectrum

- Co-Gen Absorber
  - 2,000 Tons
  - Fuel: Turbine Exhaust
- Co-Fired Absorber
  - 500 Tons
  - Fuel: Turbine Exhaust/ Natural Gas

Goals and Objectives

- Energy uses for prototype IES:
  - Electricity to local area and electric grid
  - Chilled water for air conditioning
  - Chilled water for inlet air cooling for gas turbine
  - Space heating for IES plant
  - Pre-heat makeup water for existing boilers
- Anticipated efficiency up to 76%
- Potential efficiency over 85%
- Savings through efficiency

Goals and Objectives

- 2,000 tons of co-gen cooling from generator exhaust that does not required additional fuel input
- Co-fired absorber COP raised from 1.2 to 1.5
- Develop solutions for IES integration with building control systems
- Develop interconnection procedure with the local utility

Goals and Objectives

- Educational benefits through BESL and Texas A&M University System
- Integrated control system that will allow ease of operations and remote monitoring
- Modular design will be adaptable to meet various capacity requirements and space limitations

Project Risks

- Emissions
  - Re-combusting the exhaust in the co-fired chiller may increase NOx
- Economics
  - IES efficiency compared to traditional approaches
  - Extraordinary O&M requirements
  - Must run turbine to get cheap heating/cooling
  - Volatile natural gas market

Technical Barriers

- Chilled water supply
  - Barrier: Distribution system currently supplies chilled water at 41 degrees F, absorber minimum for nameplate capacity is 44 degrees F
  - Strategy: Modify/repair/replace some air handling equipment (VAV boxes, air handling units) so that we can supply 44 degrees F chilled water
  - Barrier: Variable chilled water flow rate
  - Strategy: Decouple the chiller loops from the distribution loop, replace distribution pumps

Technical Barriers

- Building controls
  - Barrier: Controls are outdated/non-functioning
  - Strategy: Owner will update controls through normal maintenance
- Turbine exhaust stream
  - Barrier: Chiller has two exhaust inlets, requiring the exhaust stream to be split
  - Strategy: Control damper, logic, and sequences

Technical Barriers

- Electrical interconnection
  - Barrier: CPS has limited experience connecting DG to its T&D system
  - Strategy: Work closely with CPS to help establish interconnection procedures
- Soils
  - Barrier: Poor soil conditions at the site
  - Strategy: Put piers under building structure, looking into using integral sumps in the cooling tower system

Milestones

Completed

- Notification of selection – August 2001
- Site selected for project – September 2001
- Preliminary construction cost estimate – April 2002

Planned

- Re-submit proposal to DOE – May 2002
- Begin construction – Fall 2002
- Commission IES – Late Spring 2003
- Complete testing – Fall 2003
- Submit final report – December 2003

Expanding the BCHP Team

- Collaborating organizations
  - City Public Service of San Antonio
  - Brooks Energy and Sustainability Lab, a Texas A&M University System Laboratory
  - Texas Engineering Experiment Station
  - University of Texas, San Antonio
  - Department of the Air Force
  - EPRI
  - GTI
  - Energy Recovery International

Impact of Project/Summary

- Expect a strong positive impact on the IES program:
  - On track to meet DOE program goals
  - Cost share over 60% of total cost
  - Opportunity to solve problems that will likely be encountered at other federal sites
  - Design will be expandable and repeatable
  - System has potential for widespread commercial implementation
  - Develop database to verify performance

Questions?

Solar Turbines
A Caterpillar Company

Burns & McDonnell
SINCE 1898